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Chemical and Nutritional Quality of Slaughter Pigs by-Products

Đordje Okanović[1]
Milutin Ristić
Šandor Kormanjoš
Zvonko Nježić
Institut for food technology in Novi Sad, Novi Sad, Serbia
Slobodan Lilić
Institute of Meat Hygiene and Technology, Belgrade, Republic of Serbia
Radoslav Grujić
Faculty of Technology Zvornik, Univerzity of Istočno Sarajevo, Republika Srpska, Bosnia and Herzegovina

Abstract: Under industrial conditions of slaughtering of pigs, cattle and poultry inedible by-products are obtained besides meat. A lot of these by-products represent a possible source for production of feed ingredients of animal origin and technical fat. For better utilization of animal materials and production of qualitative products it is necessary to recognize well characteristics of these materials.

This study shows results of investigations of basic chemical composition, nitrogen fractions and amino acid composition, of some inedible by products from slaughtering of animals, with aims of indication of their high potentials.

Obtained results indicate that the examinated inedible by-products of slaughtered pigs (blood, intestines without their contents, mixed meat-fatty wastes and confiscates (lungs)) represent potent source of nutritive materials for production of valuable feeds. Mixed meat-fatty wastes are characterized by their high fat content (38%), and blood can be seen as significant source of essential amino acids.

Chemical composition of examined bovine bones show that fresh bones are a good medium for processing into a raw material for the production of gelatin and bone marrow for chemical industry.

Key words: pigs, by-products, chemical characteristics

Introduction

The importance of harmless removal of secondary animal origin products without exploitation and with it, grows with an intensified cattle breeding production, increased capacities of industrial laughter houses, building of new small slaughter houses and plants for meat processing. Solution of the problem on harmless removal of the wastes of animal origin has gone through different stages and was always closely connected to diseases which occurred with animals and people (Ristić et al., 2003).

With respects of realization of this, appears the necessity of organized collection, storaging and disposal of animal by products from slaughtering of animals by their technical processing in specialized plants, which from this raw material obtain (depending on category foreseen in the Regulation EU 1774/2002) high-quality animal feed or the raw materials for biofuels production (biogas, biodiesel) with the complete protection of the environment (Okanović et al., 2009).

The quality of products obtained by processing of animal waste materials depends largely on the composition of the starting raw material. Chemical analyses of by-products of animal origin show that even the raw material with the same structure does not have exactly the same composition. This is conditioned by different cell metabolisms of certain tissues. Chemical composition of tissues is effected by several factors-

[1] Correspoding author: E-mail: djordje.okanovic@fins.uns.ac.rs

kind of animal, species, age, gender, size, posture and exploitation of the animal and its health condition. Depending on the degree of affects of come of the mentioned factors, chemical composition of tissues is changed, and thus the composition of inedible by-product (Ristić et al., 2008a).

The recognition of characteristics of these materials is indispensable prerequisite for carrying out of technological process, for proper materials handling as well as for constructing of the equipment used for reception and processing of inedible slaughtering by-products (Okanović et al., 2008).

By products obtained by slaughtering of healthy animals, from nutritional point of view, are significant sources of proteins, fats and mineral substances, so that they can be used for production of high quality feeds and fats (Ristić et al. 2003).

In order to determine the use value of animal raw materials earmarked for technical processing, in this study the basic chemical and some nutritional characteristics of inedible by-products of animal slaughter, were determined.

Materials and Methods

For examinations were used inedible by products from slaughtering of pigs, three-race hybrids: Pietrain x (Swedish Landrace x Large Yorkshire), awerage weight 105 kg. Five samples of each blood, intestines without contents, mixed meat-fatty wastes and confiscates (lungs) were analyzed.

Samples were put in plastic bags, labeled and taken into refrigerator at about 4°C. Four hours after the slaughter, samples were transferred into chemical laboratory. All samples prior to examination were ground with homogenizer and after that used for chemical composition determinations.

Estimations of chemical characteristics of inedible by-products were performed in laboratories of the Scientific Institute for foot technologies in Novi Sad.

Basic chemical composition of by-products was established by determining water content (JUS ISO 1442, 1997), proteins (JUS ISO 937, 1991), free fats (JUS ISO 1443, 1997) and total ash (JUS ISO 936, 1998). Collagen content of the connecting tissue was determined indirectly, by the determination of the content of specific amino acid in collagen –

hydroxyproline (JUS ISO 3496, 2002) and then multiplying by the factor of 8.

Nitrogen fractions and digestible nitrogen were determined according to AOAC method (1984).

For amino acids composition, amino-analyzer Biotronic LC 5001 was used. Protein hydrolysis was performed with 6 mol/L HCl for 23 h at 110°C. Cystine and methionine were ore-oxidized with performic acid (15 h at 2°C (Moor, 1963).

With respect of right interpretation of the determined data, they were statistically evaluated with calculations of arithmetic mean ($\overline{X}$) and standard deviation (Sd) values (Hadživuković, 1991).

Rezults and discussion

Chemical characteristics of by products from pigs slaughter are shown in Tables 1, 2 and 3.

Chemical composition of by products obtained from slaughtered animals depends on many factors, but, before of all, on kinds and structure of raw materials (Ristić at al. 2008). Chemical analyses of animal by products show that even raw material with the same structure has not totally identical compositions. It is caused by different metabolisms in cells of the defined tissues. Chemical compositions of tissues depend

on many factors, i.e. species and race of animals, their sex, degree of fattening and use of animals and their health condition. Depending on degree of effects of the named factors changes chemical composition of tissues, and, at the same time, of their inedible by products (Park at al. 1996).

Besides to these factors, chemical, and even physical characteristics of animal by products depends and treatment of raw material from the place of its origin till its entrance into processing (Carretero at al., 2000).

Results of estimation of basic chemical composition of inedible by products from slaughtering of pigs are given in Table 1.

Basic chemical composition of wastes obtained by slaughtering of pigs (Table 1) was different with respect to some of parameters found in the available references, what can be seen as a consequence of sampling methods, which depend on purpose of investigation, as well as of their pretreatment (Gómez-Juárez at al., 1999). In cases of examination of pure wastes, their partition is performed on individual anatomy parts, which are, in the course of pretreatment, obtained without attached matters. These investigations were performed with aims of finding data for raw materials in a shape which is such as it will be during further treatment, what assures results fore more detailed recognizing of their further processing.

Table 1. Basic chemical composition of inedible by products of slaughtered pigs

By-product	Moisture %		Crude proteins %		Free fats %		Ash %		N-free extracts %
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$
Blood	79,46	1,55	18,90	1,05	0,32	0,08	0,82	0,05	0,50
Intestines without contents	70,38	2,16	7,99	095	13,00	3,12	0,48	0,07	8,15
Mixed meat-fatty wastes	48,76	1,63	11,10	1,94	38,00	2,98	2,04	0,97	0,10
Confiscates (lungs)	77,36	3,78	13,62	1,81	5,81	1,11	1,32	0,65	1,89

Inedible by products of slaughtered pigs differ according to their moisture contents. Besides of mixed meat-fatty wastes, all other categories of analyzed by products contain more than 70% of moisture. This surely may be important for choice of processing procedure for these raw materials, together with contents and nature of individual components that are included in their structure.

Besides to protein component, these raw materials contain significant content of fats, especially mixed wastes and intestine samples (over 50% in dry substance, confiscates (over 44% in dry substance) and bones. Significant fat contents in by products obtained by slaughtering of pigs justify application of extractive technological procedures.

Crude fibers were not present in any group of samples, while nitrogen-free extractive substances (BEM) in considerable percents were found only in intestine samples without their contents.

Nitrogen fractions and digestible nitrogen of inedible by products obtained during slaughtering of pigs are shown in Table 2. Nitrogen complex of the investigated by products from slaughtering line form predominantly proteins, and quantities of ammonia nitrogen indicate that in time of from sampling up to

analysis observable processes of dezamination have not taken place. Free amino acid contents are also in limits of their normal contents if time period between sampling and analyzing of samples is taken in account. Because neither in production conditions raw material will normally not immediately processed, the obtained results for nonproteinaceous fractions practically reflect the state of these raw materials when they were generated in the slaughter house.

Table 2. Nitrogen fractions and digestible nitrogen of inedible by products of slaughtered pigs

By-product	Protein N, %		Non protein N, %		α-amino N (mg/100g)		Ammonia N (mg/100g)		Digestible N (%)
	$\overline{x}$	SD	$\overline{x}$	SD	$\overline{x}$	SD	$\overline{x}$	SD	$\overline{x}$
Blood	2,96	1,95	0,29	0,06	153	3,45	107	4,12	3,08
Confiscates	1,65	0,19	0,11	0,81	43	2,11	26	2,25	1,73
Intestines without contents	1,20	0,51	0,07	0,06	18	0,25	17	2,01	1,21
Mixed meat-fatty wastes	1,73	0,45	0,05	0,04	7	0,23	4	1,44	1,75

Digestible nitrogen of all samples lies very close to the total nitrogen content, what indicates that almost total quantity of proteins is ready to be metabolized in animal organism after their consumption in the processed form.

Amino acid compositions of inedible by products (Table 3.) proteins from line of slaughtering of pigs shows that these raw materials possess valuable potential for processing into animal feeds. The most valuable raw material is, undoubtedly, blood, whose proteins contain about 50% of essential (Leucine, Isoleucine, Lysine, Methionine, Threonine, Phenilalanine, Tryptophan, Valine) and 10.5% of semi essential (Histidine and Arginine) amino acids. Share of essential amino acids in proteins of intestine without contents, confiscates as well as of mixed meat-fatty wastes varies from nearly 33 to 36%, and of semi-essential ones from over 8 up to 10 %.

Of individual amino acids, very significant is high lysine content, then threonine content, and also the phenylalanine content in proteins of these raw material. Methionine is not, according to these results, present in larger quantities, what is possible to explain with it's degradation during preparing of samples for analyze. Results obtained for methionine contents are probably lower than actual contents of this amino acid in the examined samples.

Presence of nonessential amino acids is also important, while, in the case of their efficiency in the complete ration, essential amino acids are consumed. In these raw materials, from that point of view, especially important is presence of glycine in intestine without their contents.

In the World, exist different technological methods for animal wasters processing. Each of them has its own specifications that reflect themselves on the quality and yields of products. During processing, protein structures are changed and particular amino acids react with other substance present in raw material. Yields of the obtained products, i.e. quantities of the obtained proteinaceous feeds and fats based on unity of raw materials, besides of the relation of particular components, directly depend on method of fats separation and on processing losses of individual substances, i.e. on the applied technological process (Ristić et al., 2008a).

Table 3. Amino acid compositions of inedible by products of slaughtered pigs (% in crude proteins)

Amino acid	Blood		Confiscates		Intestines without contents		Mixed meat-fatty wastes	
	$\overline{x}$	SD	$\overline{x}$	SD	$\overline{x}$	SD	$\overline{x}$	SD
Leucine	11,38	3,57	8,68	3,75	7,85	2,26	7,53	2,26
Isoleucine	2,10	1,06	3,67	0,51	4,17	2,20	4,96	2,20
Lysine	8,96	2,21	7,09	2,06	7,69	2.59	7,45	1,62
Methionine	3,23	0,20	1,54	1,95	1,80	1,17	1,27	0,95
Threonine	4,65	1,60	3,71	2.81	4,15	0,72	3,63	0,20
Phenylalanine	7,58	2,76	4,00	0,51	4,24	1,62	2,86	1,37
Tryptophan	3,39	0,95	1,02	0,61	1,02	0,17	1,30	0,84
Valine	8,36	1,38	5,64	1,53	5,28	2,26	4,81	2,76
Histidine	6,35	1,62	2,28	0,12	1,94	1,76	2,11	0,17
Arginine	4,15	0,17	6,66	2,20	7,49	2,53	6,75	2,53
Aspartic acid	5,48	2,75	8,61	3,55	9,08	3,57	8,31	1,38
Asparagine	3,21	2,75	4,16	3,55	4,83	3,57	5,13	1,38
Serine	5,04	0,58	4,42	1,20	4,59	0,76	4,32	0,92
Glutamic acid	3,79	2.59	7,40	2,26	6,58	0,95	7,65	1,56
Glutamin	3,16	1.59	3,81	1,46	4,05	1,05	3,95	1,11
Glycine	4,25	1,76	12,03	1,17	9,40	2.81	10,32	3,57
Alanine	6,69	2,53	6,56	1,37	6,41	2,20	6,62	0,72
Cystine	0,58	0,02	0,93	0,19	0,98	1,37	1,10	2.81
Proline	4,15	2,02	4,18	2,39	5,14	1,62	6,95	3.13
Tyrosine	2,93	0,72	2,90	0,68	3,09	1,17	2,74	1,17

Conclusion

Based on the results of investigation of basic characteristics of inedible by-products from the pigs slaughtering, the following can be concluded:

Inedible by-products from the slaughtering of animals are a significant source of protein and fat, and are a suitable raw material for processing into protein feed and technical fat.

Nitrogenous complex of the examinated raw materials is predominantly composed of proteins, present in different quantities, depending on the structure and kind of the raw material.

For all samples, digestible nitrogen is approximately equal with total nitrogen, indicating that all proteins of these raw materials is accessible for utilization in animal organism, with exception of feathers. Nondigestibility of feather proteins is well known, and their processing in digestive form is performed by hydrolysis.

Amino acid composition of the analyzed raw materials indicates that these materials are potentially convenient for proteinaceous feeds production. It should be kept in mind, that the amino acid compositions of individual analyzed raw materials are different.

Blood can be considered a significant source of essential amino acids, especially lysine.

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